

Mary Hegarty (1992) called the activity of inferring “the state of one component of the system given information about the states of the other system components, and the relations between the components” *mental animation* and emphasized its importance to the activities of designing, troubleshooting, and operating mechanical devices (p. 1084). Obtaining reaction time and eye movement data while people solved problems about relatively simple pulley systems, she investigated the extent to which inference processes are isomorphic to the operation of the physical systems. One way they were not isomorphic is that the participants made inferences about different components of the system (i.e., individual pulleys) separately and sequentially even though in the physical system the components operated simultaneously. The participants found it considerably harder, however, to make inferences that required them to reason backward through the system rather than forward, suggesting that they animated the system sequentially from what they represented as the first operation, in this respect preserving isomorphism with the actual system.

Accepting the claim that people, including scientists, understand diagrams of mechanisms by animating them, a natural follow-up question concerns how they do this. A plausible initial proposal is that they create and transform an image of the mechanism so as to represent the different components each carrying out their operations. In perception we have experience of parts of the system changing over time, and so the proposal is that in imagination we animate these components by invoking the same processes that would arise if we were to watch an animated diagram. This proposal needs to be construed carefully, as a potential misunderstanding looms. Reference to a mental image should not be construed as reference to a mental object such as a picture in the head. Recent cognitive neuroscience research indicates that when people form images they utilize many of the same neural resources that they do in perception (Farah, 1988; Kosslyn, 1994).¹² Thus, what occurs in the head in forming an image is activity comparable to that which would occur when seeing an actual image. Barsalou (1999) speaks of this neural activity as a *perceptual symbol*.

which also provides links to Terry’s diagrams, is <http://www.people.virginia.edu/~rjh9u/atpyield.html>.

¹² Within cognitive science there has been a heated controversy over whether the representations formed in the cognitive system are really image-like (Kosslyn, 1981; Kosslyn, 1994; Pylyshyn, 1981; Pylyshyn, 2003). This discussion can remain neutral on this issue since the fundamental issue is not how the cognitive system encodes its representations but what it represents something as. The visual system represents objects as extended in space and changing through time. What is important here is that scientists can represent mechanisms mentally in much the way that they represent diagrams that they encounter (albeit with less detail than when actually looking at the diagram).